example, the drill rig operator may monitor any parameters impressed upon locating signal 98 such as, for instance, boring tool temperature, battery status, roll, pitch and proximity to an underground utility. In this latter regard, the reader is referred to U.S. Pat. No. 5,757,190 entitled A SYSTEM INCLUDING AN ARRANGEMENT FOR TRACKING THE POSITIONAL RELATIONSHIP BETWEEN A BORING TOOL AND ONE OR MORE BURIED LINES AND METHOD which is incorporated herein by reference.

Please replace the paragraph appearing from page 13, line 20, to page 14, line 20, with the following:

Referring to Figure 5, another feature may be incorporated in the first and second component arrangements which is not a requirement, but which nonetheless is highly advantageous with regard to drill rig status monitoring performed by the drill rig operator. Specifically, a rig monitor section 190 may be included for monitoring the aforementioned operational parameters such as drilling mud, push force and any other parameters of interest. As previously described, proper monitoring of these parameters is critical since catastrophic equipment failures or damage to underground utilities can occur when these parameters are out of range. In accordance with this feature, processor 114 receives the status of the various parameters being monitored by the rig monitor section and may provide for visual and/or aural indications of each parameter. Visual display occurs on operations status display 174. The display may provide real time indications of the status of each parameter such as "OK", as shown for drilling mud and push force, or an actual reading may be shown as indicated for the "Boring Tool Temperature". Of course, visual warnings in place of "OK" may be provided such as, for example, when excessive push force is detected. Audio warning may be provided by an alarm 192 in the event that threshold limits of any of the monitored parameters are violated. In fact, the audio alarm may vary in character depending upon the particular warning being provided. It should be mentioned that with the two-way telemetry link between the drill rig and locator/controller according to the aforedescribed first component arrangement, displays 164 and 174 may advantageously form part of overall display 150 on locator/controller 140, as shown in Figure 4, which may also include alarm 192. However, such operational status displays on the locator/controller are considered as optional in this instance since the relevant parameters may be monitored by the drill rig operator. The full advantages of rig monitor section 190 and associated operations status display 174 will come to light in conjunction with a description of a fully automated arrangement to be described immediately hereinafter.

In the Claims

A clean copy of the claims has been provided immediately hereinafter for entry in the case.

39. In a drilling system for performing underground boring including a drill rig and a boring tool which is configured for moving through the ground under control of the drill rig to form an underground bore, a monitoring arrangement comprising:

a detection arrangement at said drill rig for monitoring at least one operational parameter to produce a data signal relating to at least one of a utility to be installed in the underground bore, the drill rig and the boring tool;

a portable device configured for receiving the data signal relating to the operational parameter for use by the portable device; and

a communication arrangement for transferring the data signal from the drill rig to the portable device.

40. (once amended) The monitoring arrangement of Claim 39 wherein said communication arrangement includes a

telemetry link between the detection arrangement at the drill rig and the portable device for transferring the data signal to the portable device.

41. The monitoring arrangement of Claim 39 wherein the portable device includes a display arrangement configured for using the data signal for display to an operator of the portable device.

42. The monitoring arrangement of claim 39 wherein said boring tool includes a locating signal transmitter which transmits a locating signal for locating an underground position of the boring tool and wherein said portable device includes a locating section for receiving the locating signal for use in identifying the underground position of the boring tool.

43. The monitoring arrangement of claim 39 wherein said drilling system includes a drill string extending from the drill rig to the boring tool configured for receiving a push force applied by the drill rig to move the boring tool in a forward direction and wherein said monitoring arrangement includes a push force sensing arrangement which generates a push force signal for inclusion as at least a portion of said data signal.

44. The monitoring arrangement of claim 39 wherein said operational parameter is capable of violating at least a selected one of a minimum and a maximum predetermined value and wherein said communication arrangement is configured for transferring, as part of said data signal, a warning to said portable device that the selected predetermined value has been violated.

45. The monitoring arrangement of claim 44 wherein said portable device is configured for providing at least a selected one of an audio indication and a visual indication in response to receipt of said warning.

46. The monitoring arrangement of claim 39 wherein said operational parameter is capable of violating at least a selected one of a minimum and a maximum predetermined value and wherein said portable device is configured for issuing a warning that the selected predetermined value has been violated.

47. The monitoring arrangement of claim 39 wherein said operational parameter is a push force with which the boring tool is being pushed forward by the drill rig such that a maximum push value is established beyond which the boring tool may be damaged, said detection arrangement producing the data signal responsive to exceeding the maximum push value and wherein said portable device is configured to provide an indication of violation of the maximum push value when the maximum push value is exceeded.

48. The monitoring arrangement of claim 39 wherein said boring tool uses drilling mud provided from said drill rig and wherein said operational parameter is a status of the drilling mud for inclusion as at least a portion of said data signal.

49. The monitoring arrangement of claim 48 wherein said portable device is configured to provide an operator warning based on the status of said drilling mud.

50. The monitoring arrangement of claim 39 wherein said boring tool is attached to and moved by a drill string having one minimum bend radius and extending from the drill rig and a utility to be installed includes another minimum bend radius and wherein said detection arrangement at the drill rig includes a drill path monitoring arrangement for monitoring

curvature of the underground bore being formed by the boring tool as said operational parameter and for comparing at least a selected one of the minimum bend radius of the drill string and the minimum bend radius of the utility with the curvature of the underground bore to form at least a portion of said data signal.

51. The monitoring arrangement of claim 50 wherein said portable device is configured for indicating that the selected minimum bend radius is being violated.

52. The monitoring arrangement of claim 51 wherein the selected minimum bend radius is a greater one of the minimum bend radius of the drill string and the minimum bend radius of the utility and the portable device is configured to provide an indication of violation of the greater minimum bend radius.

53. In a drilling system for performing underground boring including a drill rig and a boring tool which is configured for moving through the ground under control of the drill rig to form an underground bore, a method comprising the steps of:

monitoring at least one operational parameter using a detection arrangement at said drill rig to produce a data signal relating to at least one of a utility to be installed in the underground bore, the drill rig and the boring tool; and

transferring the data signal, relating to the operational parameter, to a portable device for use by the portable device.

54. (once amended) The method of Claim 53 including the step of providing a telemetry link between the detection arrangement at the drill rig and the portable device and said transferring step includes the step of using the telemetry link for transmitting the data signal to the portable device.

55. The method of Claim 53 wherein the portable device includes a display arrangement and said method includes the step of using the data signal for a display presentation to an operator of the portable device.

56. The method of claim 53 wherein said boring tool includes a locating signal transmitter which transmits a locating signal for locating an underground position of the boring tool and wherein said method includes the step of configuring the portable device for receiving the locating signal for use in identifying the underground position of the boring tool.

57. The method of claim 53 wherein said drilling system includes a drill string extending from the drill rig to the boring tool configured for receiving a push force applied by the drill rig to move the boring tool in a forward direction and wherein said monitoring step includes the step of sensing the push force to generate a push force signal for inclusion as at least a portion of said data signal.

58. The method of claim 53 wherein said operational parameter is capable of violating at least a selected one of a minimum and a maximum predetermined value and wherein said transferring step includes the step of sending, as at least a portion of said data signal, a warning to said portable device that the selected predetermined value has been violated.

59. The method of claim 58 including the step of indicating receipt of said warning at the portable device using at least a selected one of an audio indication and a visual indication.

60. The method of claim 53 wherein said operational parameter is capable of violating at least a selected one of a minimum and a maximum predetermined value and said method further comprising the step of issuing a warning, using said portable device, that the selected predetermined value has been violated.

61. The method of claim 53 wherein said operational parameter is a push force with which the boring tool is being pushed forward by the drill rig such that a maximum push value is established beyond which the boring tool will be damaged and wherein said monitoring step monitors the push force as said operational parameter and said transferring step sends said data signal to the portable device responsive to violation of the maximum push value when the maximum push value is exceeded.

62. The method of claim 53 wherein said boring tool uses drilling mud provided from said drill rig and wherein said monitoring step monitors a status of the drilling mud for inclusion as at least a portion of said data signal.

63. (once amended) The method of claim 62 including the step of issuing an operator warning using the portable device based on the status of said drilling mud.

64. The method of claim 53 wherein said boring tool is attached to and moved by a drill string having one minimum bend radius and extending from the drill rig and a utility to be installed includes another minimum bend radius and wherein said monitoring step monitors curvature of the underground bore being formed by the boring tool as said operational parameter and said method further comprises the step of comparing at least a selected one of the minimum bend radius of the drill string and the minimum bend radius of the utility with the curvature of the underground bore to form at least a portion of said data signal.

65. The method of claim 64 including the step of using the portable device to indicate that the selected minimum bend radius is being violated.

66. The method of claim 64 including the steps of selecting the minimum bend radius as a greater one of the minimum bend radius of the drill string and the minimum bend radius of the utility and configuring the portable device to provide an indication of violation of the greater minimum bend radius.

67. In a drilling system for performing underground boring including a drill rig and a boring tool which is configured for moving through the ground under control of the drill rig to form an underground bore, a monitoring arrangement comprising:

a detection arrangement for monitoring at least one operational parameter which is at least measurable at the drill rig to produce a data signal relating to at least one of a utility to be installed in the underground bore, the drill rig and the boring tool;

a portable device configured for receiving the data signal relating to the operational parameter for use by the portable device; and

a communication arrangement for transferring the data signal from the detection arrangement to the portable device.

68. (once amended) The monitoring arrangement of Claim 67 wherein said communication arrangement includes a

telemetry link between the detection arrangement at the drill rig and the portable device for transferring the data signal to the portable device.

69. The monitoring arrangement of Claim 67 wherein the portable device includes a display arrangement configured for using the data signal for display to an operator of the portable device.

70. The monitoring arrangement of claim 67 wherein said boring tool includes a locating signal transmitter which transmits a locating signal for locating an underground position of the boring tool and wherein said portable device includes a locating section for receiving the locating signal for use in identifying the underground position of the boring tool.

71. The monitoring arrangement of claim 67 wherein said drilling system includes a drill string extending from the drill rig to the boring tool configured for receiving a push force applied by the drill rig to move the boring tool in a forward direction and wherein said monitoring arrangement includes a push force sensing arrangement which generates a push force signal for inclusion as at least a portion of said data signal.

72. The monitoring arrangement of claim 67 wherein said operational parameter is capable of violating at least a selected one of a minimum and maximum predetermined value and wherein said communication arrangement is configured for transferring, as part of said data signal, a warning to said portable device that said predetermined value has been violated.

73. The monitoring arrangement of claim 72 wherein said portable device is configured for providing at least a selected one of an audio indication and a visual indication in response to receipt of said warning.

74. The monitoring arrangement of claim 67 wherein said operational parameter is capable of violating at least a selected one of a minimum and maximum predetermined value and wherein said portable device is configured for issuing a warning that the selected predetermined value has been violated.

75. The monitoring arrangement of claim 67 wherein said operational parameter is a push force with which the boring tool is being pushed forward by the drill rig such that a maximum push value is established beyond which the boring tool may be damaged, said detection arrangement producing the data signal responsive to exceeding the maximum push value and wherein said portable device is configured to provide an indication of violation of the maximum push value when the maximum push value is exceeded.

76. The monitoring arrangement of claim 67 wherein said boring tool uses drilling mud provided from said drill rig and wherein said operational parameter is a status of the drilling mud for inclusion as at least a portion of said data signal.

77. The monitoring arrangement of claim 76 wherein said portable device is configured to provide an operator warning based on the status of said drilling mud.

78. The monitoring arrangement of claim 67 wherein said boring tool is attached to and moved by a drill string having one minimum bend radius and extending from the drill rig and a utility to be installed includes another minimum bend radius and wherein said detection arrangement at the drill rig includes a drill path monitoring arrangement for monitoring curvature of the underground bore being formed by the boring tool as said operational parameter and for comparing at least a

selected one of the minimum bend radius of the drill string and the minimum bend radius of the utility with the curvature of the underground bore to form at least a portion of said data signal.

79. The monitoring arrangement of claim 78 wherein said portable device is configured for indicating that the selected minimum bend radius is being violated.

80. The monitoring arrangement of claim 79 wherein the selected minimum bend radius is a greater one of the minimum bend radius of the drill string and the minimum bend radius of the utility and the portable device is configured to provide an indication of violation of the greater minimum bend radius.

81. In a drilling system for performing underground boring including a drill rig and a boring tool which is configured for moving through the ground under control of the drill rig to form an underground bore, a method comprising the steps of:

monitoring at least one operational parameter which is at least measurable at said drill rig to produce a data signal relating to at least one of a utility to be installed in the underground bore, the drill rig and the boring tool; and

transferring the data signal, relating to the operational parameter, to a portable device for use by the portable device.

82. (once amended) The method of Claim 81 including the step of providing a telemetry link between the detection arrangement at the drill rig and the portable device and said transferring step includes the step of using the telemetry link for transmitting the data signal to the portable device.

83. The method of Claim 81 wherein the portable device includes a display arrangement and said method includes the step of using the data signal for a display presentation to an operator of the portable device.

84. The method of claim 81 wherein said boring tool includes a locating signal transmitter which transmits a locating signal for locating an underground position of the boring tool and wherein said method includes the step of configuring the portable device for receiving the locating signal for use in identifying the underground position of the boring tool.

85. The method of claim 81 wherein said drilling system includes a drill string extending from the drill rig to the boring tool configured for receiving a push force applied by the drill rig to move the boring tool in a forward direction and wherein said monitoring step includes the step of sensing the push force to generate a push force signal for inclusion as at least a portion of said data signal.

86. The method of claim 81 wherein said operational parameter is capable of violating a minimum or maximum predetermined value and wherein said transferring step includes the step of sending, as at least a portion of said data signal, a warning to said portable device that said predetermined value has been violated.

87. The method of claim 86 including the step of indicating receipt of said warning at the portable device using at least a selected one of an audio indication and a visual indication.

88. The method of claim 81 wherein said operational parameter is capable of violating a minimum or maximum

predetermined value and said method further comprising the step of issuing a warning, using said portable device, that the selected predetermined value has been violated.

89. The method of claim 81 wherein said operational parameter is a push force with which the boring tool is being pushed forward by the drill rig such that a maximum push value is established beyond which the boring tool will be damaged and wherein said monitoring step monitors the push force as said operational parameter and said transferring step sends said data signal to the portable device responsive to violation of the maximum push value when the maximum push value is exceeded.

90. The method of claim 81 wherein said boring tool uses drilling mud provided from said drill rig and wherein said monitoring step monitors a status of the drilling mud for inclusion as at least a portion of said data signal.

91. (once amended) The method of claim 90 including the step of issuing an operator warning using the portable device based on the status of said drilling mud.

92. The method of claim 81 wherein said boring tool is attached to and moved by a drill string having one minimum bend radius and extending from the drill rig and a utility to be installed includes another minimum bend radius and wherein said monitoring step monitors curvature of the underground bore being formed by the boring tool as said operational parameter and said method further comprises the step of comparing at least a selected one of the minimum bend radius of the drill string and the minimum bend radius of the utility with the curvature of the underground bore to form at least a portion of said data signal.

93. The method of claim 92 including the step of using the portable device to indicate that the selected minimum bend radius is being violated.

94. The method of claim 81 including the steps of selecting the minimum bend radius as a greater one of the minimum bend radius of the drill string and the minimum bend radius of the utility and configuring the portable device to provide an indication of violation of the greater minimum bend radius.

95. In a drilling system for performing an underground boring operation including a drill rig and a boring tool which is configured for moving through the ground using a drill string which extends from the drill rig to the boring tool such that the underground boring operation forms an underground bore, a monitoring arrangement comprising:

a first arrangement for transferring at least one operational parameter through the drill string from the boring tool to the drill rig, said operational parameter relating to at least one of a utility to be installed in the underground bore, the drill rig and the boring tool;

a second arrangement, at least partially located at said drill rig, for receiving the parameter from the drill string and for transmitting the operational parameter; and

a portable device configured at least for receiving the operational parameter as transmitted by the second arrangement for use by the portable device.

96. In a drilling system for performing an underground boring operation including a drill rig and a boring tool

which is configured for moving through the ground using a drill string which extends from the drill rig to the boring tool such that the underground boring operation forms an underground bore, a method comprising the steps of:

transferring at least one operational parameter through the drill string from the boring tool to the drill rig, said operational parameter relating to at least one of a utility to be installed in the underground bore, the drill rig and the boring tool; and

transmitting a data signal, relating at least to the operational parameter as received, from the drill rig to a portable device for use by the portable device.

Please add new claims 97-104, as follows:

Sub D13

--97. (new claim) The monitoring arrangement of Claim 39 wherein said detection arrangement is configured for detecting a range of the operational parameter for which an out of range condition of the operational parameter can result in a catastrophic equipment failure.--

Sub E1

--98. (new claim) The monitoring arrangement of Claim 97 wherein the detection arrangement is further configured for detecting the operational parameter as at least one of a push force which drives the boring tool, a temperature of the boring tool, a pressure of a drilling mud that is supplied to the boring tool, a status of a battery used in the boring tool, a curvature of the underground bore and a proximity of the boring tool to an underground utility.--

Sub D14

--99. (new claim) The method of Claim 53 wherein said monitoring step includes the steps of configuring the detection arrangement for detecting a range of the operational parameter for which an out of range condition of the operational parameter can result in a catastrophic equipment failure.--

C12 Sub E1

--100. (new claim) The method of Claim 99 including the step of detecting the operational parameter as at least one of a push force which drives the boring tool, a temperature of the boring tool, a pressure of a drilling mud that is supplied to the boring tool, a status of a battery used in the boring tool, a curvature of the underground bore and a proximity of the boring tool to an underground utility.--

Sub D15

--101. (new claim) The monitoring arrangement of Claim 67 wherein said detection arrangement is configured for detecting a range of the operational parameter for which an out of range condition of the operational parameter can result in a catastrophic equipment failure.--

Sub E1

--102. (new claim) The monitoring arrangement of Claim 101 wherein the detection arrangement is further configured for detecting the operational parameter as at least one of a push force which drives the boring tool, a temperature of the boring tool, a pressure of a drilling mud that is supplied to the boring tool, a status of a battery used in the boring tool, a curvature of the underground bore and a proximity of the boring tool to an underground utility.—

Sub D16

--103. (new claim) The method of Claim 81 wherein said monitoring step includes the steps of configuring the detection arrangement for detecting a range of the operational parameter for which an out of range condition of the operational parameter can result in a catastrophic equipment failure.--

Sub E1

--104. (new claim) The method of Claim 103 including the step of detecting the operational parameter as at least